

# Curso Inteligência Artificial: do Zero ao Infinito

## Evaluation Metrics

Universidade Federal de Mato Grosso

# Agenda

- 1 Introduction
- 2 Localization
- 3 Classification
- 4 Precision x Recall
- 5 Mean Average Precision

# Introduction

In object detection, evaluation is non trivial, because there are two distinct tasks to measure:

- Determining the location of the object (localization, a regression task).
- Determining whether an object exists in the image (classification)

Fonte: Understanding the mAP Evaluation Metric for Object Detection

# Localization

## IoU

- In order to evaluate the model on the task of object **localization**, we must first determine how well the model predicted the location of the object.
- The localization task is typically evaluated on the **Intersection over Union threshold** (IoU).

Fonte: Understanding the mAP Evaluation Metric for Object Detection

# Localization

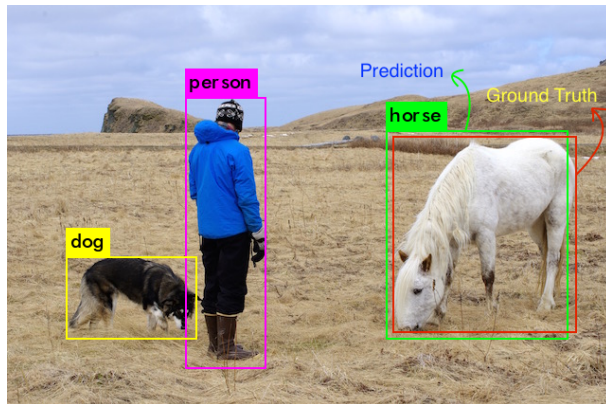
## IoU

- **Intersection over Union** is a ratio between the intersection and the union of the predicted boxes and the ground truth boxes.
- To get the intersection and union values, we first overlay the prediction boxes over the ground truth boxes.
- Now for each class, the area overlapping the prediction box and ground truth box is the intersection area and the total area spanned is the union.

Fonte: Measuring Object Detection models ? mAP ? What is Mean Average Precision?

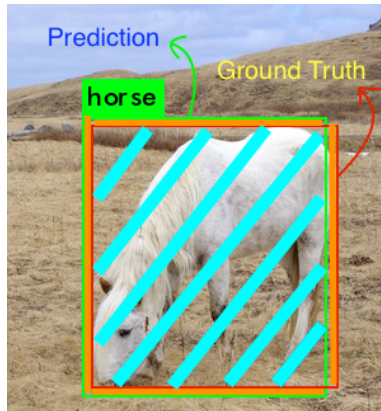
# Localization

IoU



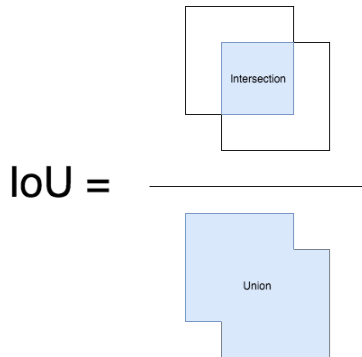
# Localization

IoU



# Localization

IoU





# Classification

## mAP

- In a typical data set there will be many classes and their distribution is non-uniform.
- For example there might be many more dogs than cats.
- There is the need to associate a "confidence score" with each bounding box detected and to assess a level of confidence.

Fonte: Understanding the mAP Evaluation Metric for Object Detection

# Classification

## mAP

- In order to address these needs, the Average Precision (AP) was introduced.
- To understand the AP, it is necessary to understand the **precision** and **recall of a classifier**.

Fonte: Understanding the mAP Evaluation Metric for Object Detection

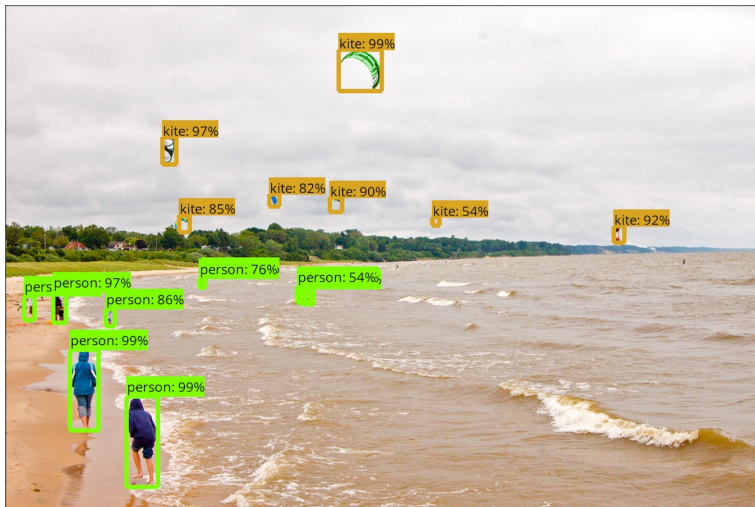
# Precision x Recall

$$\textit{Precision} = \frac{\textit{Actually Class 1} \cap \textit{Predicted Class 1}}{\textit{Predicted Class 1}} = \frac{\textit{True Positives}}{\textit{True Positives} + \textit{False Positives}}$$

$$\textit{Recall} = \frac{\textit{Actually Class 1} \cap \textit{Predicted Class 1}}{\textit{Actually Class 1}} = \frac{\textit{True Positives}}{\textit{True Positives} + \textit{False Negatives}}$$

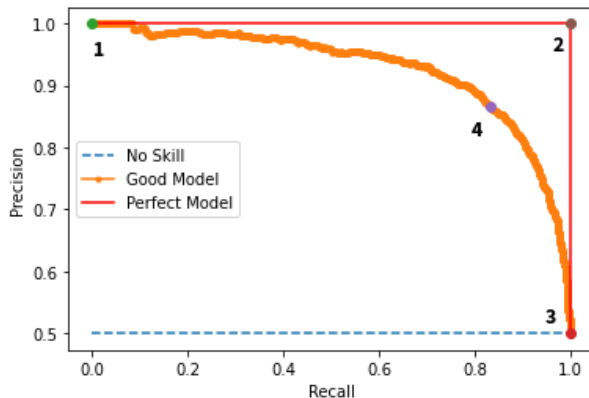
Fonte: Complete Guide to Understanding Precision and Recall Curves

# Precision x Recall



Fonte: [https://github.com/tensorflow/models/tree/master/research/object\\_detection#tensorflow-object-detection-api](https://github.com/tensorflow/models/tree/master/research/object_detection#tensorflow-object-detection-api)

# Precision x Recall



Fonte: Complete Guide to Understanding Precision and Recall Curves

# Precision x Recall

- The **mean Average Precision** or mAP score is calculated by taking the mean AP over all classes and/or over all IoU thresholds

Fonte: Complete Guide to Understanding Precision and Recall Curves

- Measuring Object Detection models ? mAP ? What is Mean Average Precision?
  - ▶ [https://towardsdatascience.com/what-is-map-understanding-the-statistic-of-choice-for-comparing-object-dete](https://towardsdatascience.com/what-is-map-understanding-the-statistic-of-choice-for-comparing-object-detection-models-1a1e1e1e1e1e)
- Complete Guide to Understanding Precision and Recall Curves
  - ▶ <https://analyticsindiamag.com/complete-guide-to-understanding-precision-and-recall-curves/>

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